Texas Technology Showcase

Energy-Efficient Process Technologies and Best Practices

Chemical and Refining Industries

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Ultra-Low NOx LeanPremix Burners Eliminate SCRs for Process Heaters

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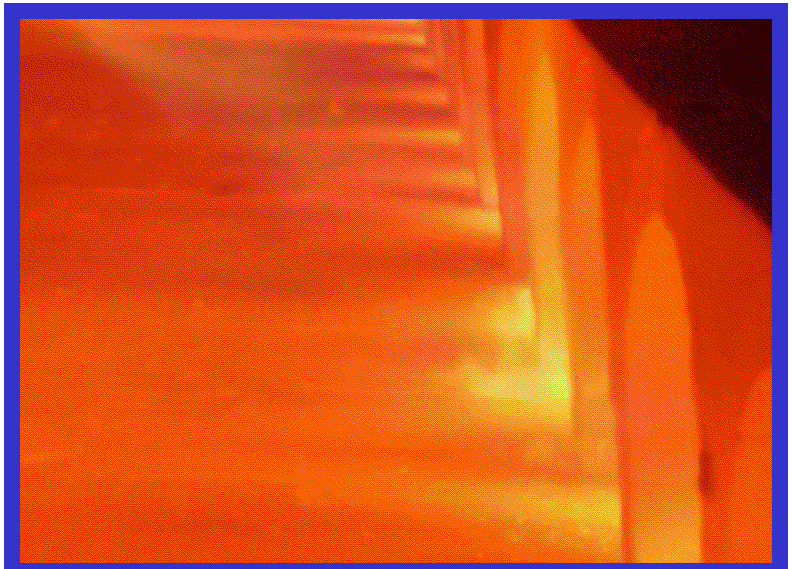
Richard Waibel, John Zink Co., LLC

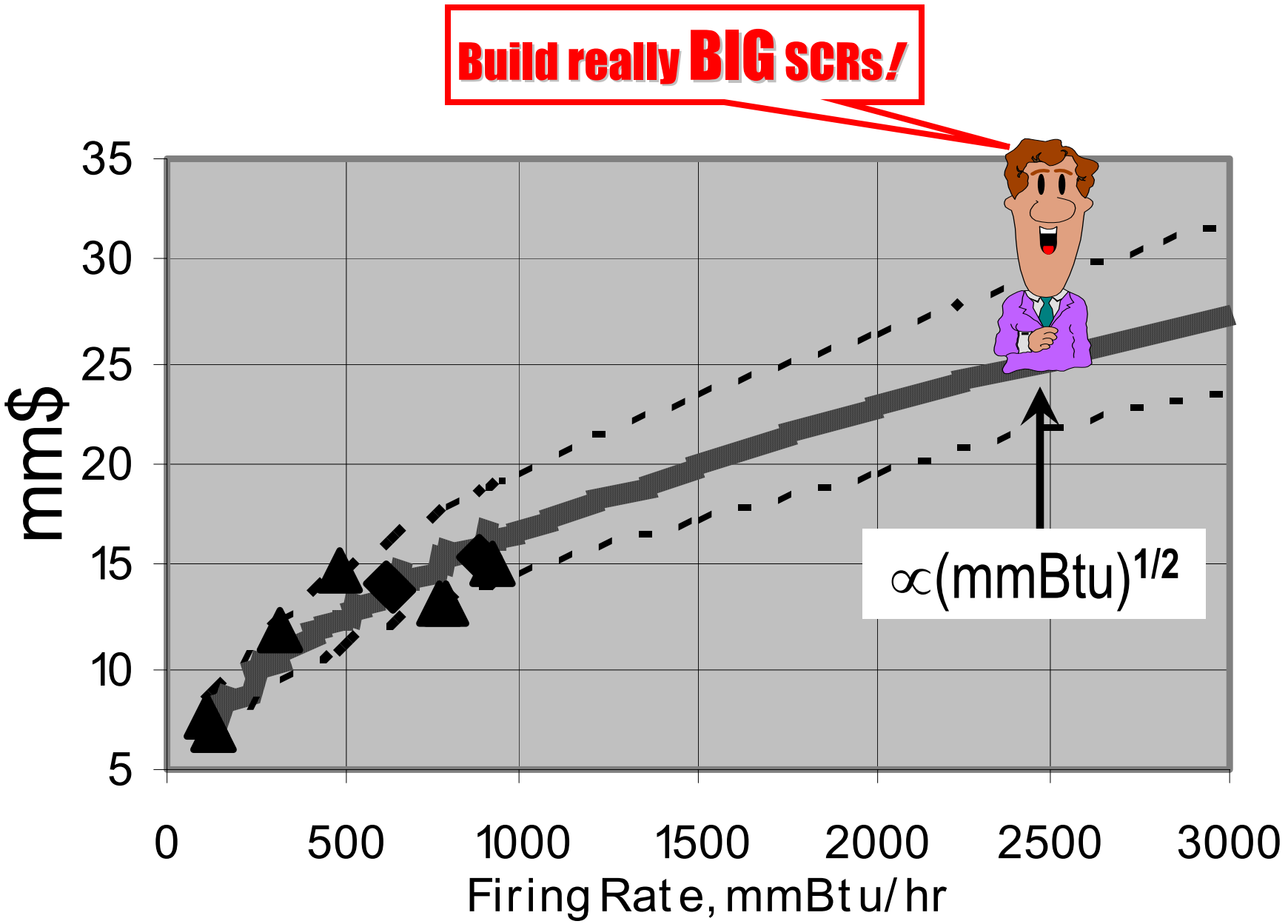
What we would *LIKE* to do!



What we would like *NOT* to do!

OK, fine, you may *prefer* to do burners, but which SCRs make the *most* sense*?*

- **Really *BIG* ones …**
- **The bigger the better …**
- **They're *all* highly effective …**
- **But the bigger they are the more cost-effective they become*!***


Build really BIG SCRs!
35
30
25
20
15
10
5
mm$
0
500
1000
1500
2000
2500
3000
Firing Rate, mmBtu/hr
∝(mmBtu)1/2

Be Safe or …

… I'll KILL you !


Pre-lift Safety Talk


NOx REDUCTION PROJECT
SCR PACESETTER+
SAFETY AS A VALUE
TECHNIP

Why we don't like SCRs too much . . .

It's only money!

. . . but when we *HAVE* to go for SCR,

BIGGER is BETTER!

Developing and Retrofitting Ultra Low NOx Burners in a Refinery Furnace

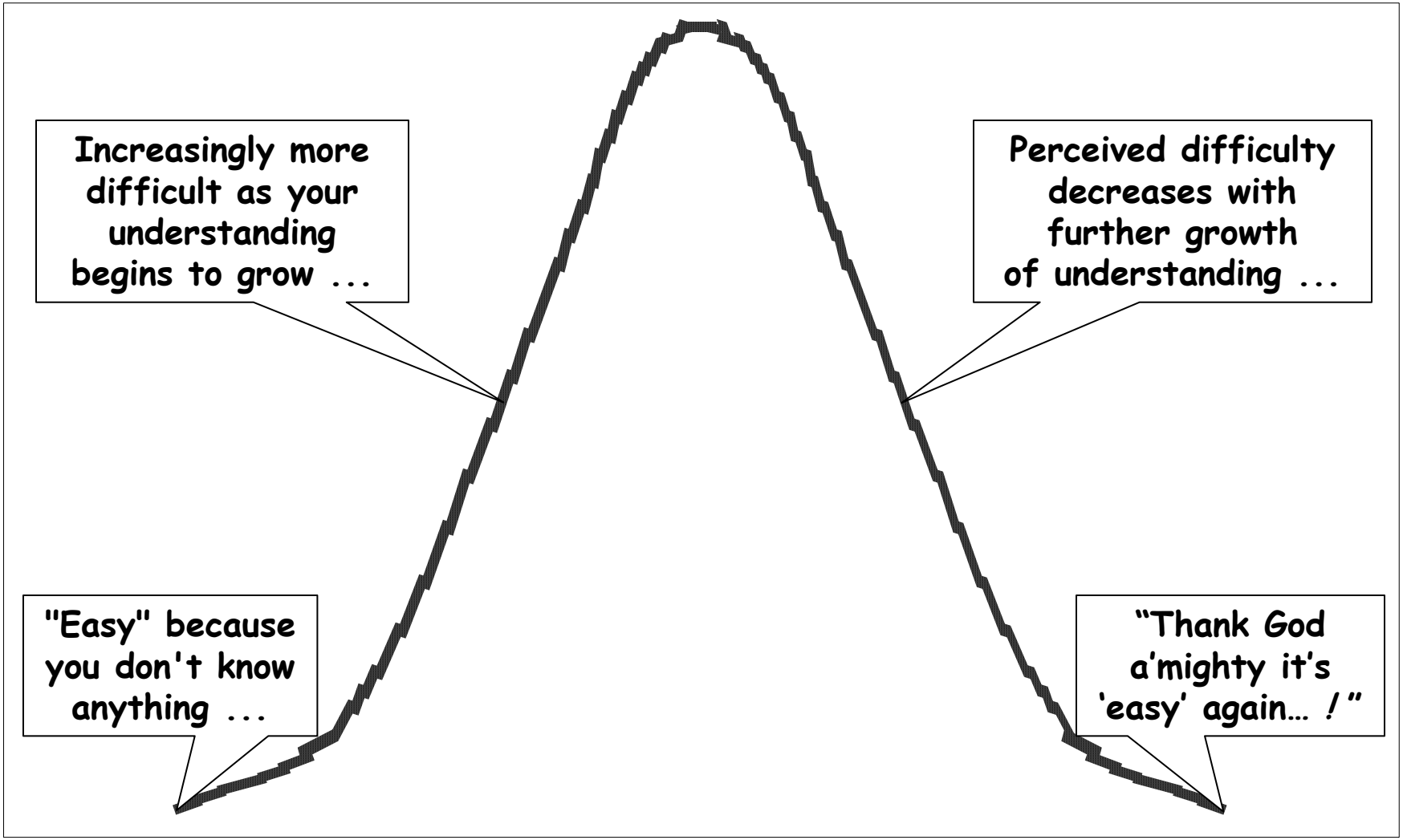
The Skunk Works Approach!

JOHN ZINK
JOHN ZINK COMPANY LLC

ChevronTexaco

TECHNIP-COFLEXIP

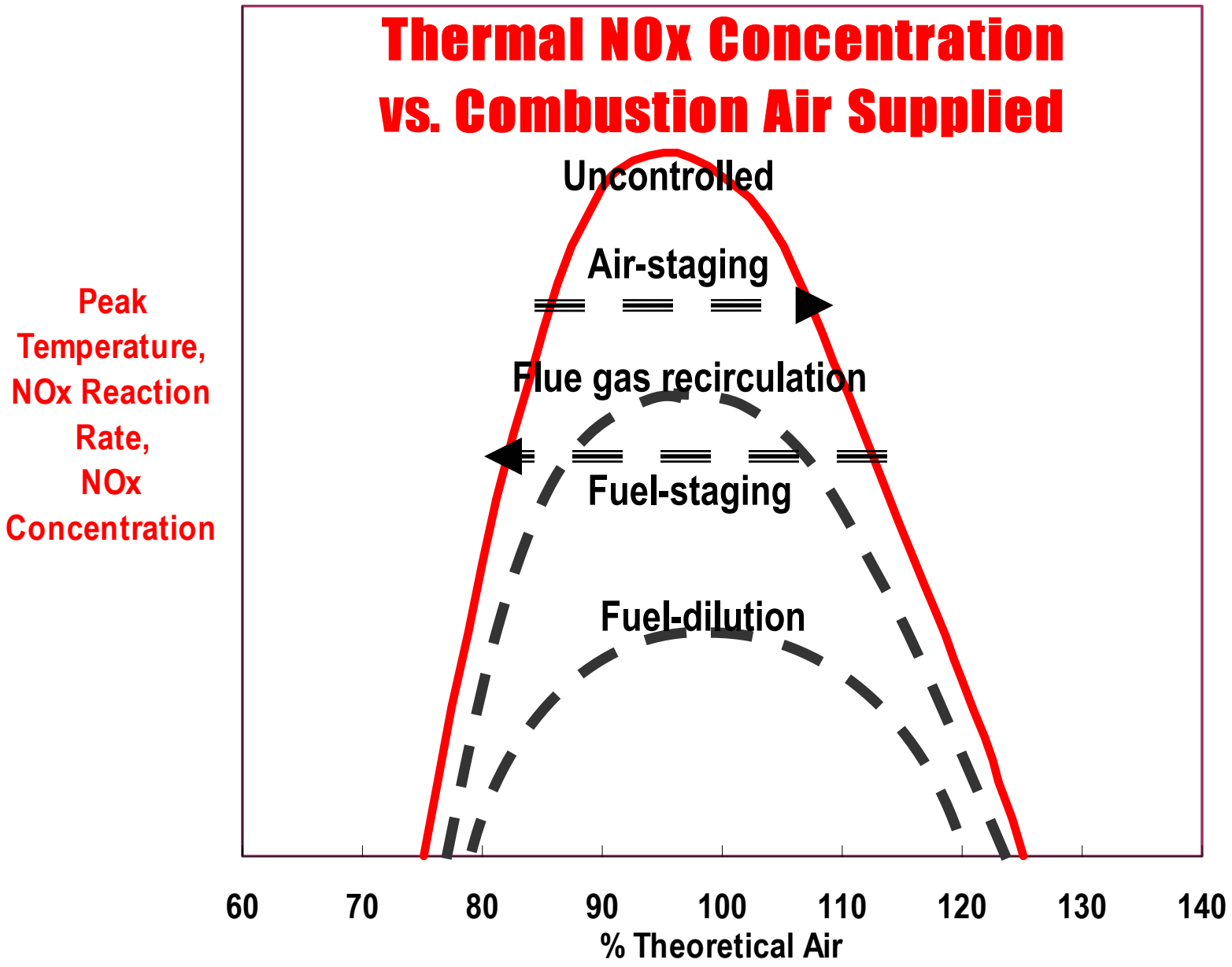
Perception of Difficulty vs. Understanding

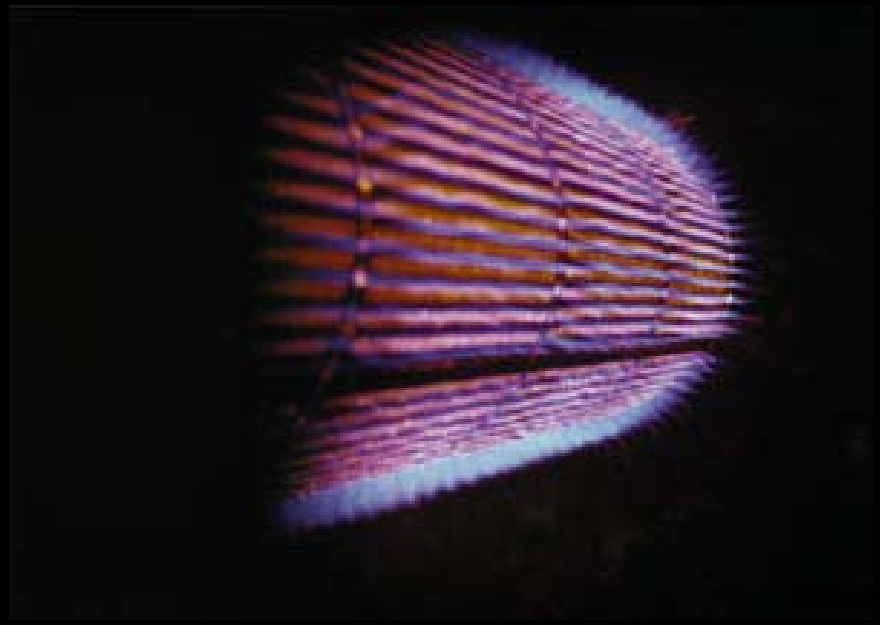


Difficulty

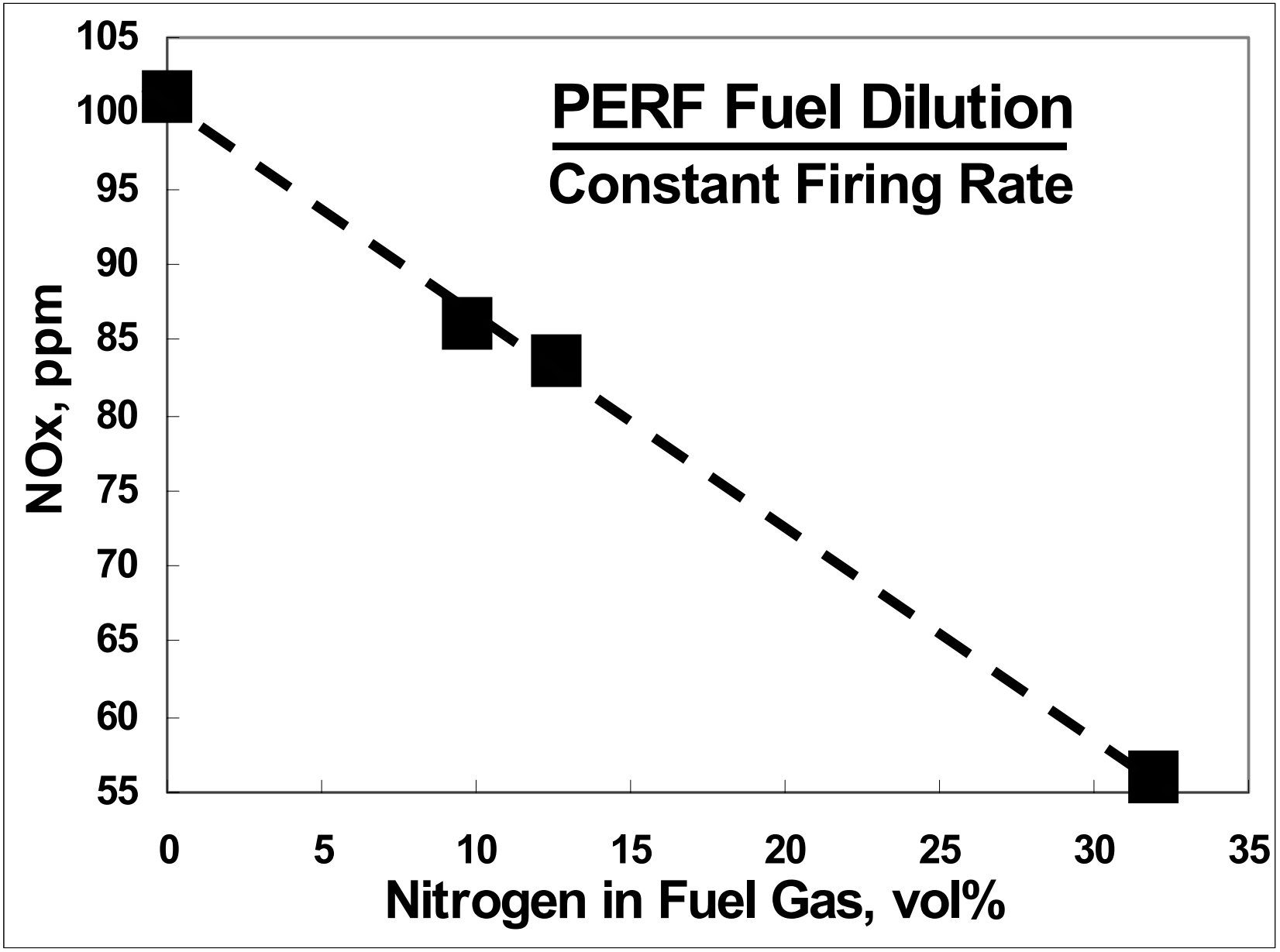
Understanding

Lots of ways to skin a cat?



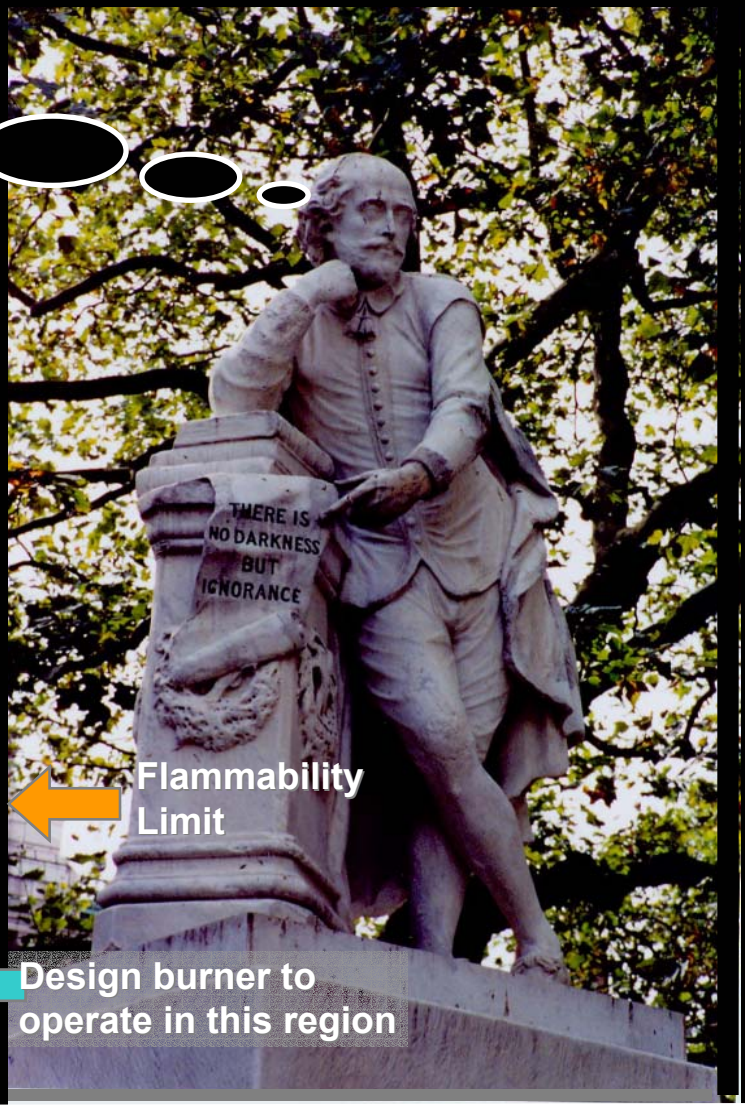


Not really . . . it's all about making a low-Btu fuel!



ULTRA LEAN PREMIX

The Trick?
Deep penetration into the low-Btu regime whilst maintaining flame stability!



Relative NOx Emissions

Region of Stoichiometric Combustion

Diffusion Flame

Premix Flame

Flammability Limit

Design burner to operate in this region

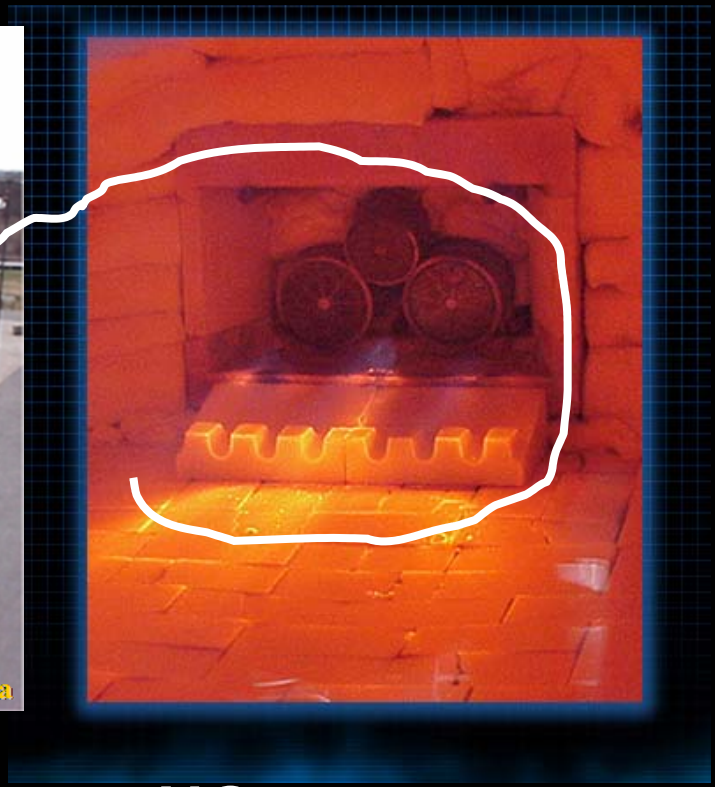
Fuel rich combustion

Fuel lean combustion

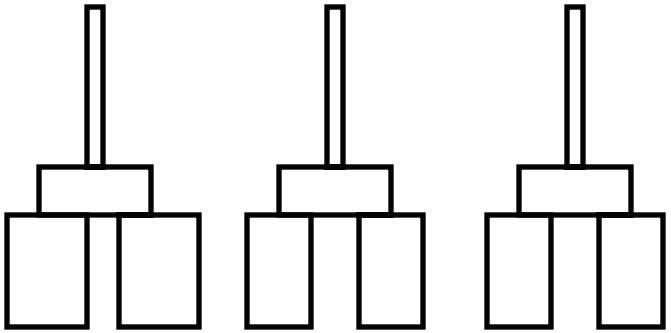
Air as the Diluent

John Zink LPM 305F

Lean PreMix Burner in the Test Furnace



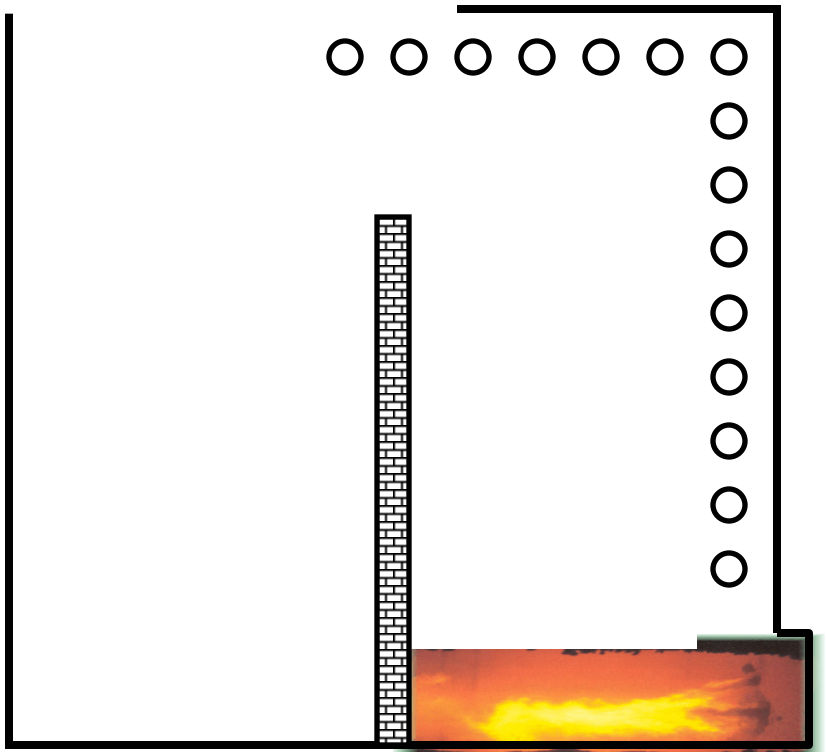
Fuel		NOx	
1,440 Btu/scf	(27% H_2)	9 ppm	(@ 3% O_2, 1700°F)
810 Btu/scf	(65% H_2)	10 ppm	(@ 3% O_2, 1700°F)

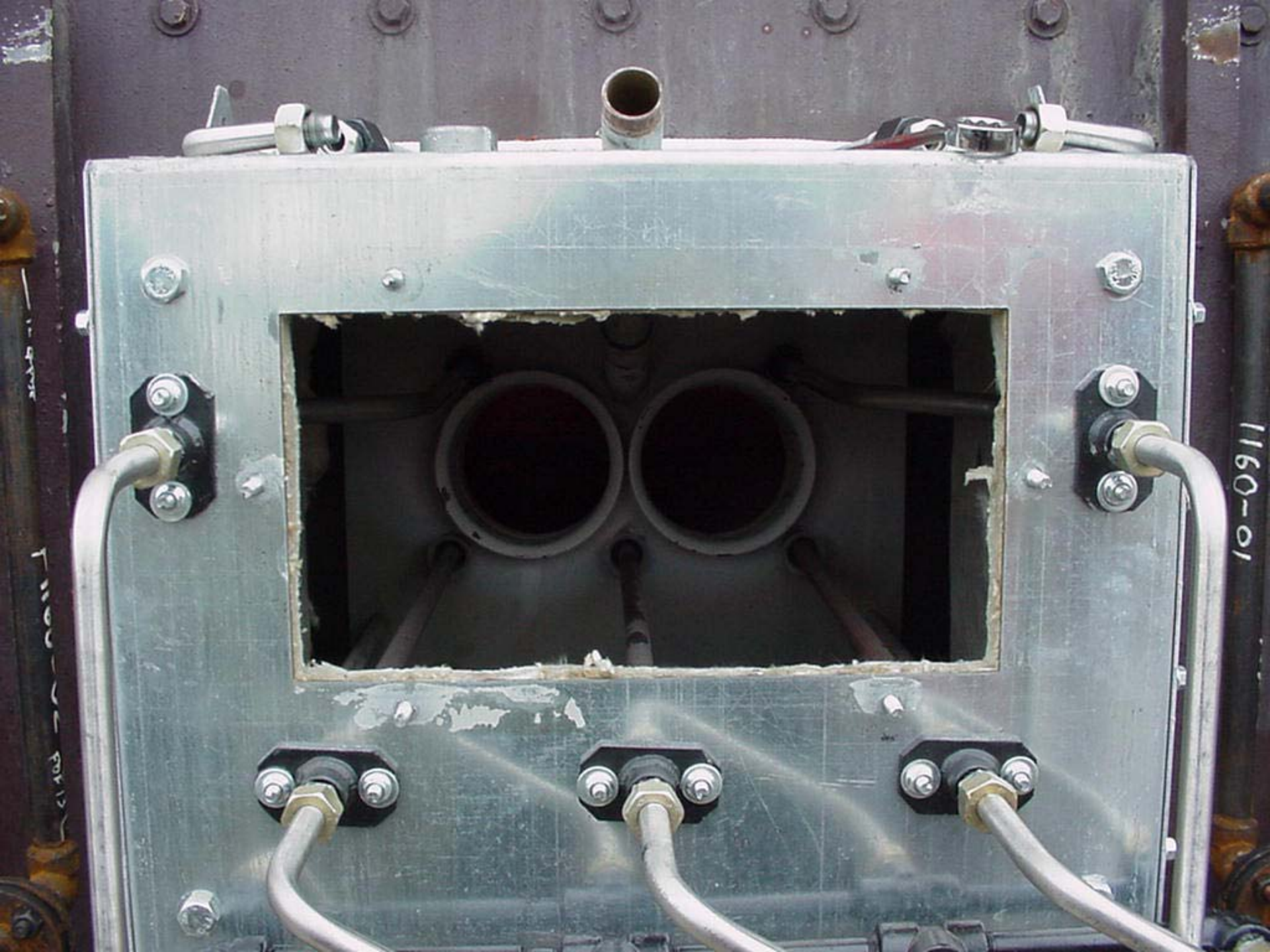


Chevron Richmond

#4 Crude Unit

Ultra^2 Low NOx Burner Retrofit




1160-01

SCR Reduction (92%) at a Burner Price!

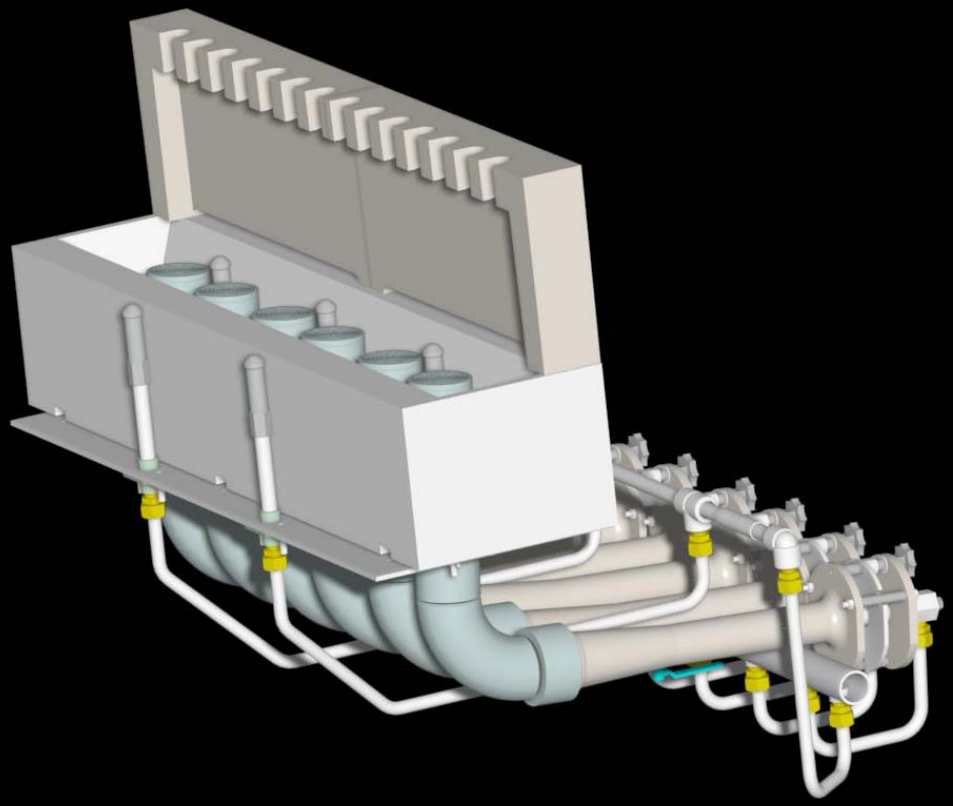
For process heating you DON'T need a selective catalytic reduction flue gas treatment plant but you really DO need burners so why not super-low NOx burners?

Before 180 ppm

After 15 ppm


3 Cell Terrace Wall Furnace
22 8 Burners
250 MW total input
2002 3 1

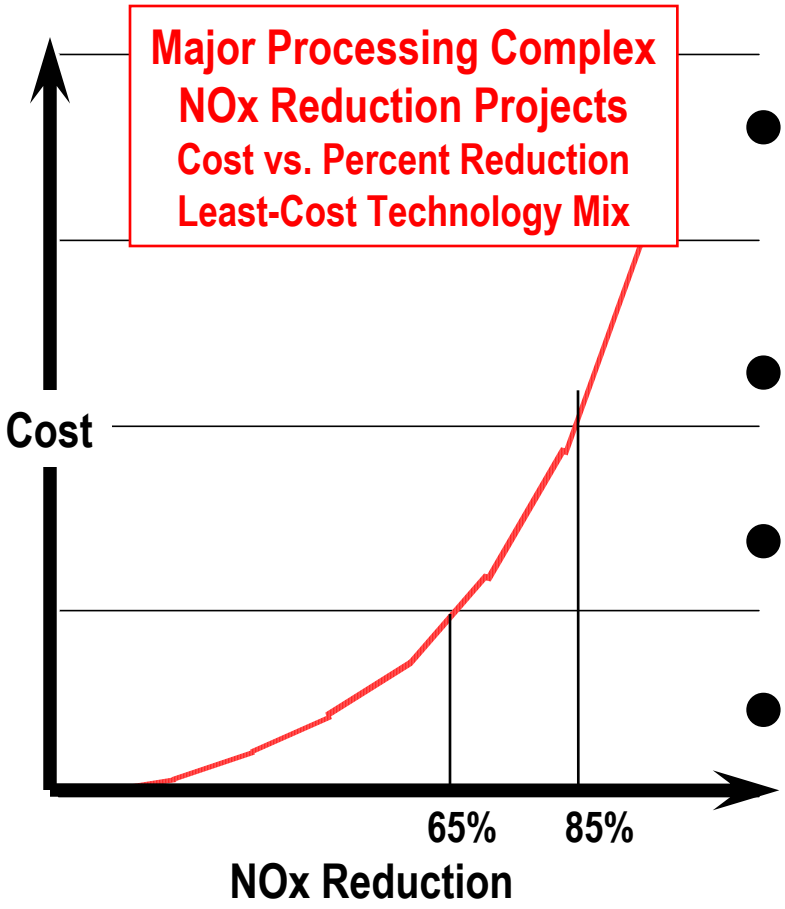
John Zink LeanPreMix LPM 304F



Test Furnace: 12 ppm
Field Application: <15 ppm
Original Burner: ~150 ppm

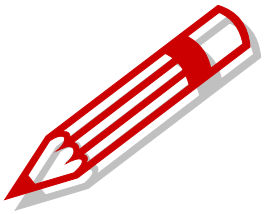
NOx Reduction Retrofits

Cost Impact of Reduction Mandates



- Shape of curve confirmed in every capital project we have either done or studied
- Significant difference between 65% and 85%
- That kind of difference roughly DOUBLES the cost
- Paying public & stockholders like the lower cost better

OK, here's the deal …



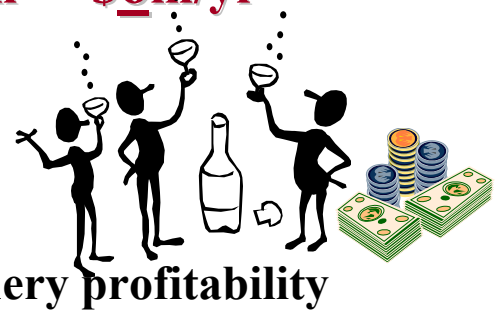
On a big furnace or string of furnaces breeched together:

	Burners	SCR
CapEx	~$6-million	~$16-million
OpEx	0	~$700-900,000/yr ~$1.4-1.6 million/yr
Excess O_2	2% (~$350,000/yr)	6%

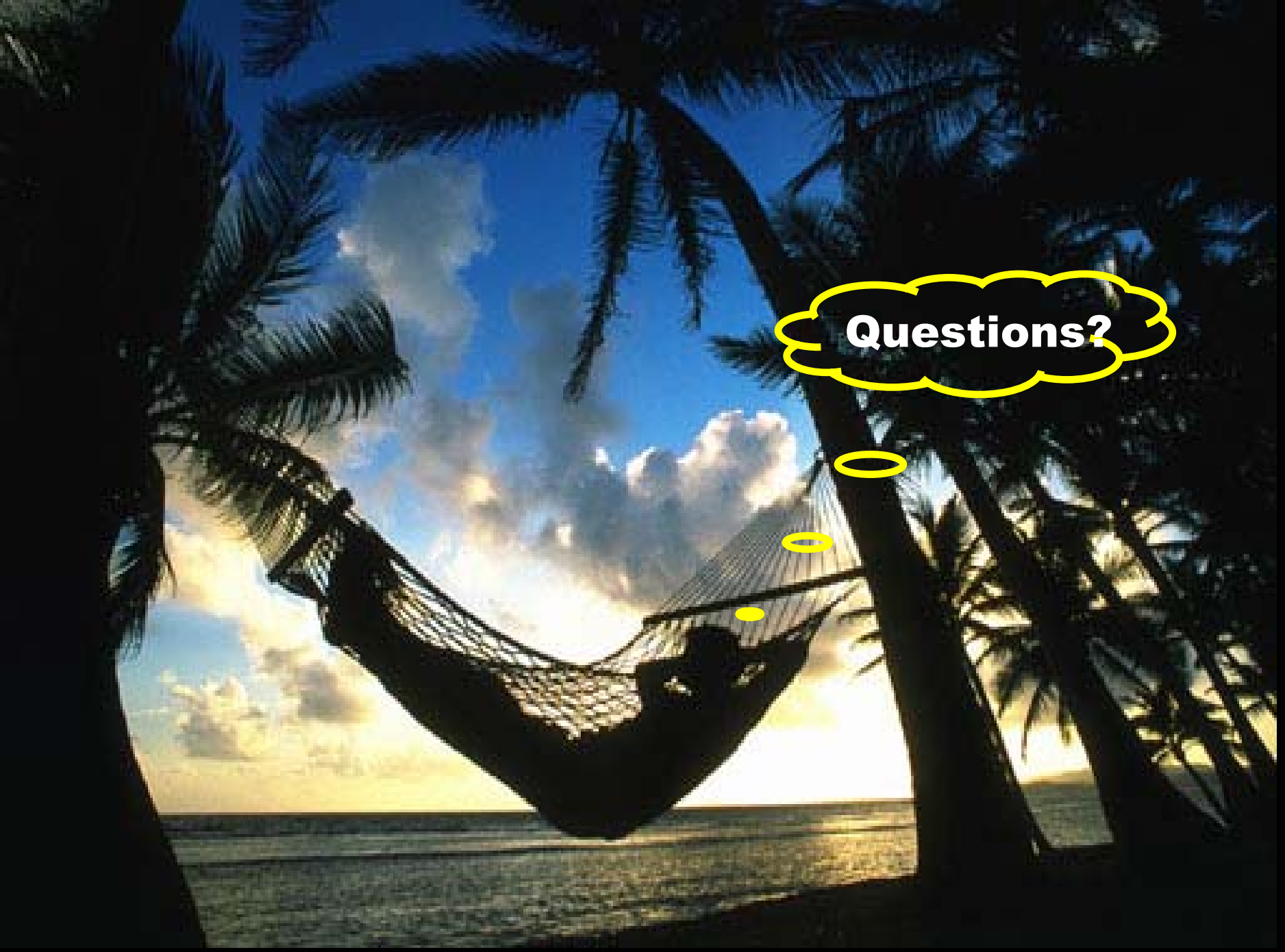
A Passion for Technology Innovation & Application

Chevron Richmond NOx Project — Huge Savings by Inspiring & Supporting the Development of Extremely Low-NOx Burners

	CapEx	OpEx
No SCR at the boiler house! …….	~$10m	~$2m/yr
No SCR at crude unit F1100/F1160! …	~$10m	~$2m/yr
No SCR at hydrogen reformer F355! …	~$10m	~$2m/yr
	~$30m	~$6m/yr



- ☺ **Intense collaboration with burner suppliers**
- ☺ **32 vacuum cell burners installed *on-the-run***
  - ➲ **Favorable margins — *NO* shutdown contributed to refinery profitability**
- ☺ **Synergy with Chevron Phillips Chemical Co's NOx Project**
- ☺ **"EYE" thrust upgrades Energy *(↓ fuel use)*, Yield *(↑ feed rate and run length)* and Environmental *(↓ emissions)* performance!**


Questions?